

ORIGINAL ARTICLE

A survey of radiographers' confidence and self-perceived accuracy in frontline image interpretation and their continuing educational preferences

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Abstract

Introduction: The provision of a written comment on traumatic abnormalities of the musculoskeletal system detected by radiographers can assist referrers and may improve patient management, but the practice has not been widely adopted outside the United Kingdom. The purpose of this study was to investigate Australian radiographers' perceptions of their readiness for practice in a radiographer commenting system and their educational preferences in relation to two different delivery formats of image interpretation education, intensive and non-intensive. **Methods:** A cross-sectional web-based questionnaire was implemented between August and September 2012. Participants included radiographers with experience working in emergency settings at four Australian metropolitan hospitals. Conventional descriptive statistics, frequency histograms, and thematic analysis were undertaken. A Wilcoxon signed-rank test examined whether a difference in preference ratings between intensive and non-intensive education delivery was evident. **Results:** The questionnaire was completed by 73 radiographers (68% response rate). Radiographers reported higher confidence and self-perceived accuracy to detect traumatic abnormalities than to describe traumatic abnormalities of the musculoskeletal system. Radiographers frequently reported high desirability ratings for both the intensive and the non-intensive education delivery, no difference in desirability ratings for these two formats was evident ($z = 1.66$, $P = 0.11$). **Conclusions:** Some Australian radiographers perceive they are not ready to practise in a frontline radiographer commenting system. Overall, radiographers indicated mixed preferences for image interpretation education delivered via intensive and non-intensive formats. Further research, preferably randomised trials, investigating the effectiveness of intensive and non-intensive education formats of image interpretation education for radiographers is warranted.

Introduction

Healthcare settings are under growing pressure to care for patients, reduce costs and improve quality. The Australian

population is ageing and health expenditure is increasing faster than economic growth.¹ In response to the need for health reform in Australia, government departments are promoting flexible and innovative use of allied health

professionals, as well as greater interprofessional teamwork.² Radiographers are well positioned to respond to these pressures by contributing to image interpretation in emergency care settings.³

Radiographers in the United Kingdom (UK) began highlighting abnormalities on radiographs in the emergency setting by affixing a red dot sticker to the radiograph more than 30 years ago.⁴ This 'red dot' indicated to the referring doctor that the radiographer had identified a potential traumatic abnormality. This type of system simply detects an abnormality. Studies in the United Kingdom have acknowledged benefits of the red dot and subsequent radiographer abnormality detection systems.^{5,6} While radiographer abnormality detection systems can aid emergency doctors in their diagnosis of trauma, it does have its failings.^{7,8} First, the 'red dot' system is voluntary in nature and does not distinguish between occasions where a radiographer has not detected an abnormality (no red dot) or has not participated in the detection system for the specific examination (also no red dot). Second, a red dot alone does not provide the referring doctor with any indication of the nature and location(s) of abnormality detected. This ambiguity substantially diminishes the potential benefit to the referrer and their patients. Consequently, evolution from radiographer abnormality detection systems to abnormality description systems is underway.^{7,8}

Radiographer detection and description is commonly referred to as radiographer commenting. Radiographer commenting systems not only identify whether an abnormality is present but they also include the provision of a written comment for consideration by the referrer and reporting radiologist. This written comment succinctly describes the location and nature of potential pathology. Radiographer commenting systems should not be confused with radiographer reporting. Radiographer reporting is quite different and involves a radiographer who has completed formal postgraduate tertiary qualifications. Radiographer reporters generate a formal written report in the same way radiologists traditionally report on radiographs. This study focuses on radiographer abnormality detection and description in the context of radiographer commenting systems, not radiographer reporting which is beyond the scope of this discussion.

Radiographer commenting is not a replacement for the definitive radiologist report, but rather provides a timely indication to the referrer regarding potential absence or presence of an acute abnormality along with a succinct written description of the location, type and number of the abnormalities present. Inexperienced junior doctors staffing emergency departments may be supported by this

system, in what is often considered the complex task of interpreting radiographs.^{9–11} Radiographer commenting has potential to improve timely diagnosis and management of patients in emergency care settings where delays between image capture and comprehensive radiological reporting occur.^{7,8,12}

Radiographer commenting has yet to be implemented widely outside the United Kingdom despite evidence that it may improve medical imaging services (and ultimately patient care) by acting as a conduit for communication between radiographers and the referring doctor.^{7,12} The successful implementation of radiographer commenting systems is dependent on radiographers' readiness for practice in this role. This involves the necessary confidence and ability of radiographers to detect and describe abnormalities on trauma radiographs. Undergraduate coursework for entry-level radiographers frequently includes some image interpretation content.⁷ However, it is currently unknown whether this education satisfactorily prepares radiographers to detect and describe abnormalities of the musculoskeletal system in emergency settings.

Previous studies among radiographers have demonstrated their confidence and accuracy to interpret radiographs improves after completing targeted image interpretation education.^{5,12–16} Effective targeted image interpretation education program for radiographers delivered in a format amenable to their ongoing professional development will likely assist in enhancing their readiness for practice in radiographer commenting systems. Postgraduate university qualifications incorporating image interpretation coursework are available in some countries including Denmark, United Kingdom and Australia. However, radiographers may find this formal university coursework inaccessible due to large time requirements and a substantial financial commitment.

An alternative to formal postgraduate university programs is targeted image interpretation training delivered in short-course formats⁷ either via an intensive delivery format or regular short tutorials. Intensive delivery is where a regular or non-intensive course (e.g. 90-min weekly tutorials conducted over 2 months) is compressed into an intensive delivery format (e.g. two consecutive 6-h days). In this context, both programs could contain the same content, structure and total delivery time, however one is delivered in an intensive format.

Prior research has been conducted in other fields to examine the merit of intensive and non-intensive teaching formats.^{17,18} In summary, these investigations have indicated that intensive teaching formats may lead to comparable or slightly more favourable learning outcomes

than non-intensive teaching formats. However, no research has investigated radiographers' perceived readiness to practice in a radiographer commenting system, their preferences for receiving intensive and non-intensive education, or whether either format leads to better learning outcomes. The purpose of this study was to investigate radiographers' perceptions of their readiness for practice in a radiographer commenting system, as well as their educational preferences for receiving intensive and non-intensive image interpretation education.

Methods

Design

A cross-sectional survey was administered via a web-based platform between August and September 2012. The questions were designed to investigate radiographers' confidence, self-perceived accuracy in trauma image interpretation and their educational preference for radiographer commenting education. The questionnaire included eight closed-ended questions and four open-ended questions.

Participants and setting

Diagnostic radiographers from four metropolitan medical imaging departments in Queensland, Australia were invited to participate. Radiographers were considered eligible for inclusion if they worked in the emergency setting of a medical imaging department, had no previous experience of participating in a radiographer commenting service and had at least completed a 48-week period of supervised practice. An overall sample of 108 diagnostic radiographers was identified as meeting the inclusion criteria.

Questionnaire content and procedure

The initial questionnaire was prepared by a study working group consisting of medical imaging professionals ($n = 3$) and health service researchers experienced in the development evaluation and implementation of web-based questionnaires ($n = 3$). The survey content was first developed by the medical imaging professionals. The health service researchers then linked the content of each item to the stated objectives of the study to ensure the item content was valid for addressing the study aims. Items not directly addressing the study objectives were removed. The questionnaire was then piloted using radiographers external to the study sample that had exposure to using abnormality detection systems. During the piloting phase of the survey

instrument, cognitive pretesting methods were used to ensure the questions were easy to understand, were interpreted as intended, and that response options were clearly understood.¹⁹ This resulted in amendments to two items due to potentially misleading language.

The final questionnaire had four sections. The first section requested demographic information including years of clinical experience and gender. The second section asked respondents to rate their confidence in participating in an abnormality detection system, as well as their confidence in detecting and describing traumatic abnormalities of the musculoskeletal system. Eleven-point rating scales were used to rate confidence, where 0 and 10 represented 'not at all confident' and 'very confident' respectively. In the third section, respondents provided ratings of their perceived level of accuracy in detecting and describing acute traumatic abnormalities of the appendicular and axial skeleton. For example, 'What is your perceived level of accuracy in describing acute traumatic abnormalities of the axial skeleton?' Ratings of perceived accuracy were recorded on 11-point scales where 0 and 10 represented 'not at all accurate' and 'very accurate' respectively.

The fourth section asked respondents to identify their perceived desirability for two formats of receiving 12 h of image interpretation education (eight 90-min sessions and 2-day intensive delivery). Desirability was rated on 11-point rating scales where 0 and 10 represented 'very undesirable' and 'very desirable' respectively. Section four also asked respondents about their perceptions of potential advantages and disadvantages of the differing formats of education. For example, after being provided with a description of the intensive education delivery format, respondents were asked 'What do you perceive are the advantages of an intensive education delivery format?'

An email containing a hyperlink to the web-based platform was distributed to all eligible radiographers. Respondents anonymously completed the questionnaire at their convenience. An email reminder was sent out 1 week before the closure of the 4-week data collection period to maximise the response rate. Approximately 15 min was required to complete the survey.

Analysis

Conventional descriptive statistics were used to describe the sample. This included the number of respondents (and percentage response rate), median (interquartile range) and total range years of radiographer experience of respondents, as well as the number (and percentage) of radiographers who were female. Prior to analyses, Cronbach's alpha²⁰ was used to confirm the internal

consistency reliability of the rating scales used by respondents to rate their confidence (coefficient = 0.77) and perceived accuracy (coefficient = 0.86), which were in the desirable range (0.70–0.90) for indicating 'good' internal consistency. Mean (standard deviation) was used to describe radiographers' confidence ratings for detecting and describing traumatic radiographic abnormalities. Frequency histograms were used to describe response distributions for radiographers' confidence in participating in a radiographer commenting system, self-perceived accuracy in detecting and describing traumatic radiographic abnormalities of the appendicular and axial skeleton, and radiographers' desirability ratings for the two potential formats of receiving image interpretation education. A Wilcoxon signed-ranked test²¹ (with a significant level of 0.05) was used to examine whether a difference in preference rating for the two potential intensity formats of education delivery existed. This non-parametric test was selected, as these preference ratings did not closely follow a normal distribution curve. Statistical analysis was undertaken using Stata/IC-(Version 11.2; StataCorp, College Station, TX, USA).

Thematic content analysis was undertaken for responses to the perceived advantages and disadvantages of the two potential formats of delivery of radiographer commenting education. This was completed by two researchers who coded similar responses together into emerging categories, independent of one another, before meeting to reach a consensus about any differing categories. A third independent researcher was available to mediate any unresolved coding disagreement between the two primary coders, however, no such disagreement occurred. The number of responses coded into each category was also recorded and expressed as a percentage of total responses. To determine the primary emerging categories of perceived advantages and disadvantages of the non-intensive format of delivery and intensive format of delivery categories were presented in order of response prevalence.

Ethics

This investigation was approved by the Human Research Ethics Committees of Metro South Health and the Queensland University of Technology. Eligible participants were provided with a study information sheet as part of the email invitation. Completing the survey implied consent. Participation was voluntary.

Results

The questionnaire was completed by 73 radiographers (68% response rate). The median (inter-quartile range)

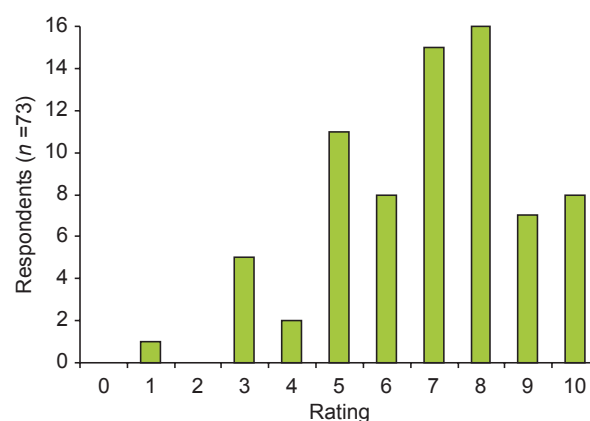


Figure 1. Histogram representing radiographers' confidence (0 = not at all confident, 10 = very confident) to participate in an abnormality detection system.

years of radiographer experience was 5 (2–10). The number of years experience working as a radiographer ranged from 1 to 36. Forty-nine (67%) respondents were female. Respondents' confidence ratings for participating in an abnormality detection system are displayed in Figure 1. The pattern of responses indicated that most respondents felt confident to participate in an abnormality detection system.

Respondents' confidence ratings to detect and describe abnormalities on trauma radiographs of the musculoskeletal system are presented in Figure 2. The pattern of responses varied between the two skills. Respondents' reported a mean (SD) confidence rating of 6.7 (1.6) to detect abnormalities. A total of 66 (90%) respondents rated their confidence to detect abnormalities at the mid-point or higher on the rating scale. While the mean (SD) confidence of respondents to describe pathology was 5.2 (1.9) on the rating scale and 51 (70%) respondents rated their confidence at the mid-point or higher on the rating scale.

Respondents' self-perceived accuracy ratings for detecting and describing traumatic abnormalities of the appendicular and axial musculoskeletal system are presented in Figure 3. The number of respondents reporting low levels of self-perceived accuracy varied across these four accuracy ratings. The number of respondents reporting low levels of self-perceived accuracy (rating of less than 5 of 10) in detecting traumatic abnormalities of the appendicular and axial skeleton in emergency settings were 1 (1%) and 9 (12%) respectively. The number of respondents reporting low levels of self-perceived accuracy (rating less than 5 of 10) in describing traumatic abnormalities of the appendicular and axial skeleton were 13 (18%) and 25 (34%) respectively.

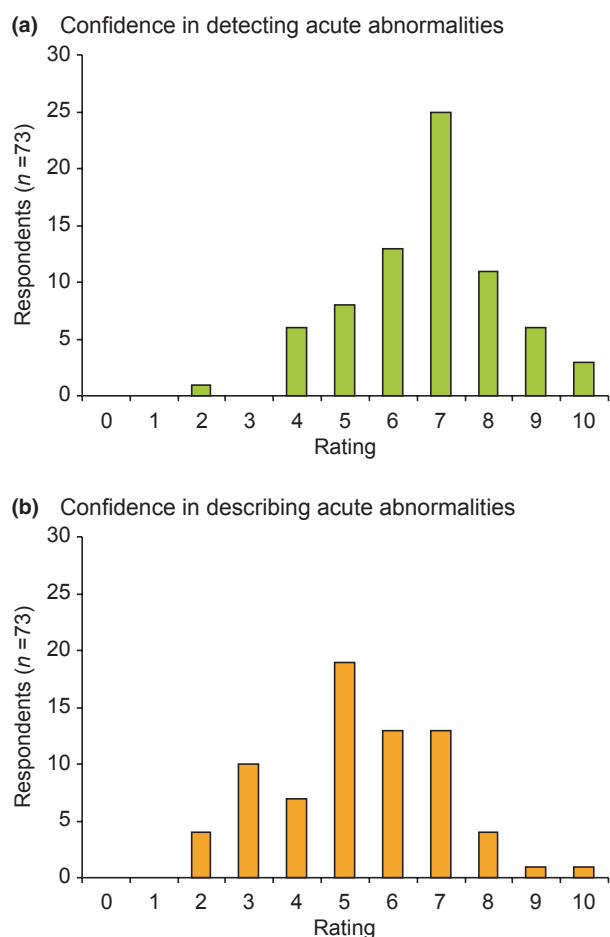


Figure 2. Histogram representing radiographers' confidence to detect and describe traumatic abnormalities (0 = not at all confident, 10 = very confident).

Respondents' desirability ratings for two different intensity formats of receiving image interpretation education are presented in Figure 4. The pattern of desirability ratings varied between the two potential education intensity formats. The Wilcoxon signed-rank test did not indicate that one intensity format had higher overall desirability ratings than the other ($z = 1.66$, $P = 0.11$). The number of respondents who reported ratings of 8 of 10 or higher for the 90-min tutorials over 2 months and intensive 2-day mode of delivery being 40 (55%) and 25 (34%) respectively. Few respondents reported low ratings (4 or less out of 10) for either the 90-min tutorials ($n = 10$, 14%) or intensive 2-day format of delivery ($n = 13$, 18%).

The summary of respondents' perceived advantages and disadvantages of eight 90-min education sessions as a non-intensive format for receiving radiographer commenting education are presented in Table 1. A total

of four perceived advantages were identified. The most frequently reported perceived advantages were opportunity to consolidate the new information and skills between sessions ($n = 27$, 37%), a gradual learning curve conducive to long-term acquisition of knowledge and skill ($n = 16$, 22%) and ability to maintain concentration and enthusiasm for 90-min sessions ($n = 16$, 22%). Responses were also coded into three categories of disadvantages. The most frequent perceived disadvantage was the long length of time commitment ($n = 49$, 67%) required to complete an 8-week education program.

Respondents reported a variety of perceived advantages and disadvantages of an intensive 2-day format for receiving image interpretation education (Table 2). A total of three perceived advantages were identified. The most frequently reported advantage was that a 2-day intensive education program was easy to attend in its entirety without potential risk of missing one or more education sessions ($n = 49$, 67%). Four categories of disadvantages were also identified from the coded responses. The two most frequent perceived disadvantages included that there may be too much information to learn rapidly ($n = 43$, 59%) and that it may be difficult to concentrate for long (6 h per day) durations ($n = 19$, 26%).

Discussion

This survey has been the first to report Australian radiographers' perceptions of their readiness to practice in a radiographer commenting system. The findings indicated that radiographers felt confident to participate in abnormality detection (Fig. 1). However, some radiographers had higher levels of confidence and self-perceived accuracy in detecting abnormalities than describing abnormalities (Figs. 2 and 3), consistent with other work in this field.^{7,8} A study conducted by Smith *et al.*,¹² reported a decrease in accuracy when radiographers were required to provide a written comment. They suggested this finding was associated with radiographers having difficulty converting their observations into words. Factors contributing to greater confidence and perceived accuracy in detecting rather than describing abnormalities may include familiarity with detection-only systems, and a perception that commenting requires a technical skill set acquired through targeted image interpretation education. Radiographers may also have higher perceived accuracy ratings in detecting and describing abnormalities of the appendicular skeleton than the axial skeleton (Fig. 3). The authors speculate that the lower levels of confidence and perceived accuracy in describing radiographs of the axial skeleton may be attributable to more complex

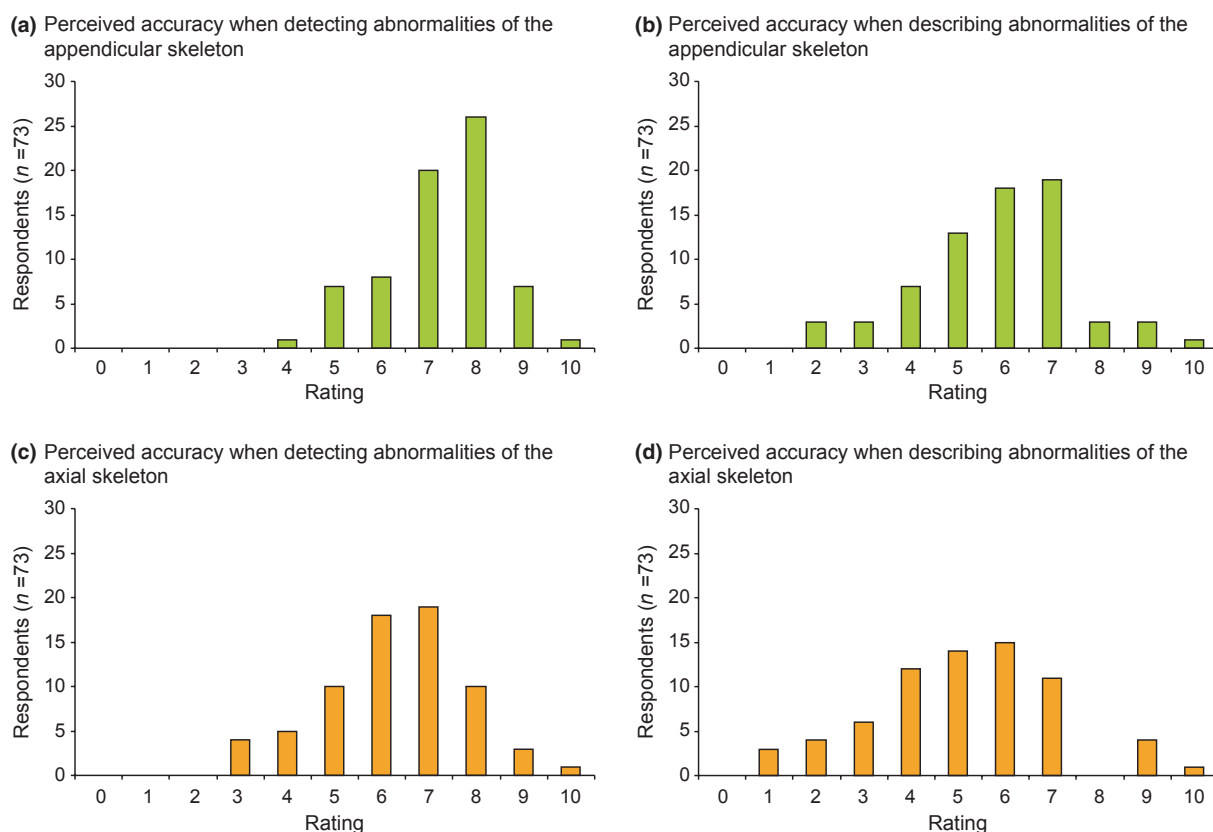


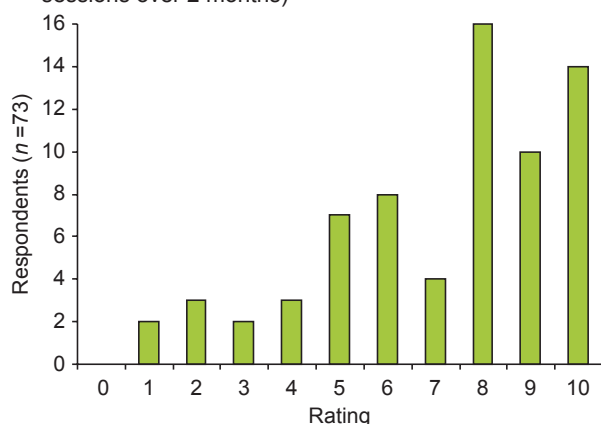
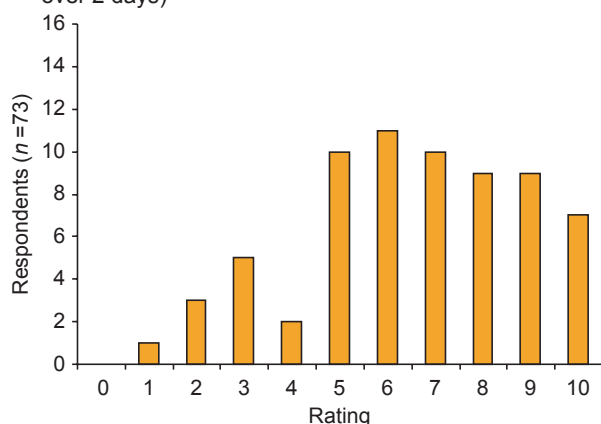
Figure 3. Histogram representing radiographers' self-perceived accuracy of detecting and describing traumatic abnormalities (0 = *not at all accurate*, 10 = *very accurate*).

anatomy and potentially more complex pathology. This finding is also congruent with previous research from Australia that examined accuracy of radiographer interpretation by body region.⁸

Image interpretation education can improve radiographers' ability and confidence to interpret and comment on radiographs in the emergency setting.^{5,12,14–16} Radiographers in this investigation frequently reported high desirability ratings for both the intensive and non-intensive education delivery formats (Fig. 4). There was no statistically significant difference between ratings for the intensive and non-intensive formats among this sample of radiographers. Despite some prior research from other fields indicating that intensive teaching formats may lead to comparable or slightly more favourable learning outcomes than non-intensive teaching,^{17,18,22} mixed opinions regarding the effectiveness of either intensive or non-intensive education programs remain.^{23,24} Radiographers from this investigation reported favourable desirability ratings for intensive and non-intensive potential formats of image interpretation education.

Radiographers in this investigation reported a range of perceived advantages and disadvantages of intensive and non-intensive image interpretation education programs that were consistent with findings from educational research from other disciplines.^{17,18,25} In summary, the perceived advantages of the intensive education format predominantly matched the disadvantages of the non-intensive format. Similarly, the perceived disadvantages of the intensive education format predominantly matched the advantages of the non-intensive format. It is likely that differences between individual radiographer's learning preferences may explain why radiographers did not consistently prefer one format over the other. Further research to evaluate which of these education delivery formats is more effective for delivering image interpretation education would be valuable for informing the future delivery of image interpretation education to radiographers.

There are important implications from this study regarding successful implementation of frontline radiographer commenting systems in emergency settings outside the United Kingdom. This study has highlighted

(a) Non-intensive format of delivery (eight 90 minute sessions over 2 months)**(b) Intensive format of delivery (two 6 hour sessions over 2 days)****Figure 4.** Histogram representing radiographers' desirability ratings for two potential intensity formats of receiving image interpretation education (0 = *very undesirable*, 10 = *very desirable*).**Table 1.** Perceived advantages and disadvantages of a non-intensive format of delivery (eight 90-min education sessions, 12 h total).

Categories	n (%)
Advantages	
Opportunity to consolidate learning between sessions	27 (37%)
Gradual learning curve conducive to long-term acquisition of knowledge and skill	26 (36%)
Able to maintain concentration and enthusiasm for 90-min sessions	16 (22%)
Easy to organise around normal life and work	4 (5%)
Disadvantages	
Long length of time commitment	49 (67%)
May forget information between sessions	16 (22%)
Session attendance may be challenging for a shift workers	8 (11%)

Table 2. Perceived advantages and disadvantages of an intensive format of delivery (2-day education session, 12 h total).

Categories	n (%)
Advantages	
Easy to attend 2-day education in entirety	49 (67%)
Intensive repetition of new skills and knowledge over 2 days may assist learning	19 (26%)
Accelerated course completion – for immediate use	5 (7%)
Disadvantages	
May be too much information to learn rapidly	43 (59%)
Challenging to concentrate for long duration of sessions	19 (26%)
Less opportunity to consolidate and revise between sessions	7 (10%)
Ruins an entire weekend or 2 days of work	4 (5%)

that some radiographers may lack confidence and perceived accuracy when describing abnormalities of the musculoskeletal system. Successful implementation of radiographer commenting systems will be dependent on radiographers' confidence and accuracy in interpreting radiographs. Access to targeted education for radiographers is likely to be helpful in this regard.^{12,13,26,27} However, in the absence of randomised trials reporting the effectiveness of image interpretation education programs for radiographers, it is difficult to draw firm conclusions regarding the intensity with which these education programs should be delivered.

Strengths, limitations and future research

There are several strengths and limitations of this research influencing the extent to which these findings can be extrapolated. The sampling approach ensured the sample represented radiographers who have had exposure to radiographer abnormality detection systems in order to address the aim of this investigation. However, radiographers with dissimilar experience and educational backgrounds may not have responded in the same way as participants in this sample. It is noteworthy that this investigation only examined radiographers' perceptions. It did not examine their actual ability to interpret radiographs nor their actual experience of different formats of education. Caution is also required before extrapolating that no statistical difference exists between radiographers' preference of the two different education delivery formats. It is plausible that a failure to reject the null hypothesis in this study may be attributed to either a lack of sensitivity in the measurement instrument or the size of this sample. Ideally, future research should evaluate the effectiveness of intensive versus non-intensive delivery of image interpretation education for radiographers, as well as their experiences in receiving

this education. A randomised controlled trial design and objective outcome measure of ability to detect and describe traumatic abnormalities would be useful for evaluating image interpretation education formats.

Conclusion

This investigation addressed its intended aim, revealing some Australian radiographers perceive they are not ready to practise in frontline radiographer commenting systems. Some radiographers lack confidence and perceived ability to accurately describe traumatic radiographic abnormalities of the musculoskeletal system. Overall, radiographers in this sample reported mixed preferences for image interpretation education delivered via intensive and non-intensive formats. It is difficult to draw firm conclusions regarding the intensity with which image interpretation education programs should be delivered in the absence of objective data from a randomised trial, reporting the effectiveness of intensive and non-intensive image interpretation education for radiographers. An education effectiveness trial of this nature remains a priority for future research.

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Conflict of Interest

The authors declare no conflict of interest.

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